

Claims

[c1] 1. A microturbine power generating system, comprising: a turbine engine for generating mechanical energy; an electrical generator that converts the mechanical energy produced by the turbine engine into electrical energy to be supplied to a utility grid; a battery source that provides dc power; a voltage boosting circuit coupled to the battery source, wherein the voltage boosting circuit increases a voltage of the battery source to produce a boosted dc power operable in a startup mode and a transient load mode; a power converter coupled to the electrical generator and the voltage boosting circuit, wherein the power converter is operable to convert the boosted dc power from the voltage boosting circuit to ac power used to cause the electrical generator to turn the turbine engine in the startup mode, and to convert ac power from the electrical generator to dc power that is added to the boosted dc power from the voltage boosting circuit in the transient load mode; a main inverter coupled to the power converter by a dc link, wherein the main inverter converts dc power on the dc link into ac power; a transformer selectively coupled to the main inverter by an ac link, wherein the transformer couples the ac power output of the main inverter to the utility grid; and a battery charging circuit coupled to the ac link and the battery source, wherein the charging circuit converts ac power on the ac link to dc power to charge the battery source in a charging mode when the turbine engine is not generating mechanical power.

2. The system of claim 1, wherein the battery source includes a single battery for providing the dc power.

3. The system of claim 1, wherein the voltage boosting circuit boosts the voltage of the battery source by a factor ranging between about five and fifteen.

[c2] 4. The system of claim 1, wherein the voltage boosting circuit includes a pulse-width modulatable energy storage unit for storing the dc power from the battery source, and wherein the system further comprises a controller for pulse width modulating the storage unit to boost the voltage.

- [c3] 5. The system of claim 1, further comprising a controller for controlling the voltage boosting circuit in the transient load mode.
- [c4] 6. The system of claim 1, wherein the battery charging circuit includes a down chopper that is responsive to the ac power from the utility grid in a charge mode, for providing dc power at a reduced voltage to the battery source.
- [c5] 7. The system of claim 6, wherein the battery charging circuit further comprises a second transformer coupled to the ac link and a second power converter for converting the ac power from the second transformer to dc power, wherein the dc power output of the second power converter is reduced by the down chopper for use in charging the battery source in a charge mode.
- [c6] 8. The system of claim 1, further comprising a controller for controlling the battery charging circuit in the charging mode.
- [c7] 9. The system of claim 8, wherein the battery source is recharged as a function of battery source voltage, battery charge current and battery source temperature.
- [c8] 10. The system of claim 8, wherein the battery charging circuit includes a second pulse-width modulatable power averaging unit for reducing the dc power from the second power converter, and wherein the system further comprises a controller for pulse width modulating the storage unit to reduce the voltage from the utility grid.
- [c9] 11. The system of claim 1, wherein the ac link between the main inverter and transformer is open in the charging mode.
- [c10] 12. The system of claim 1, wherein operation of the voltage boosting circuit is controlled by solid state switches.
- [c11] 13. The system of claim 1, wherein operation of the battery charging circuit is controlled by solid state switches.
- [c12] 14. A method of providing transient load support in a microturbine power generating system, the system including a turbine engine and an electrical

generator, wherein the electrical generator produces variable frequency ac power that is converted to dc power by a power converter, and the dc power output is provided on a dc link to an inverter that converts the dc power to single frequency ac power, the method comprising:

detecting a transient load condition during normal operation of the turbine engine;

boosting the dc power from a battery source to a desired value; and combining the boosted dc power with the dc power output of the converter to support the transient load.

[c13] 15. The method of claim 14, wherein detecting the transient load includes detecting a voltage drop on the dc link.

[c14] 16. The method of claim 14, further comprising monitoring the dc link voltage for a transient load on the system and a battery source current for excess discharge.

[c15] 17. A method of charging a battery source in a microturbine power generating system, the system including a turbine engine and an electrical generator, wherein the electrical generator produces variable frequency ac power that is converted to single frequency ac power on an ac link, and the single frequency ac power is coupled from the ac link to a utility grid by a transformer, the method comprising:

[c16] when the utility grid is energized and the electrical generator is not running, performing the steps of:
opening the ac link to isolate the electrical generator;
providing ac power from the utility grid that is on the ac link to a single phase transformer, which converts the ac power from the ac link to a single phase ac power;
providing an output of the single phase transformer to a power converter to convert the single phase ac power output to dc power;
reducing the dc power output of the power converter to a desired voltage using a down chopper circuit; and
charging the battery source with the reduced dc power from the down copper

circuit.

- [c17] 18. The method of claim 17, wherein charging the battery source include charging the battery in response to the battery source voltage, battery current and battery source temperature.
- [c18] 19. The methods of claim 17, further including providing a portion of the single phase ac power from the single phase transformer to a heating system for warming the battery source.